TACOM
Lethality, Survivability, Mobility and Sustainment for America's Army

FCS Multi-role Armament and Ammunition System

NDIA Armaments for the Army Transformation Conference

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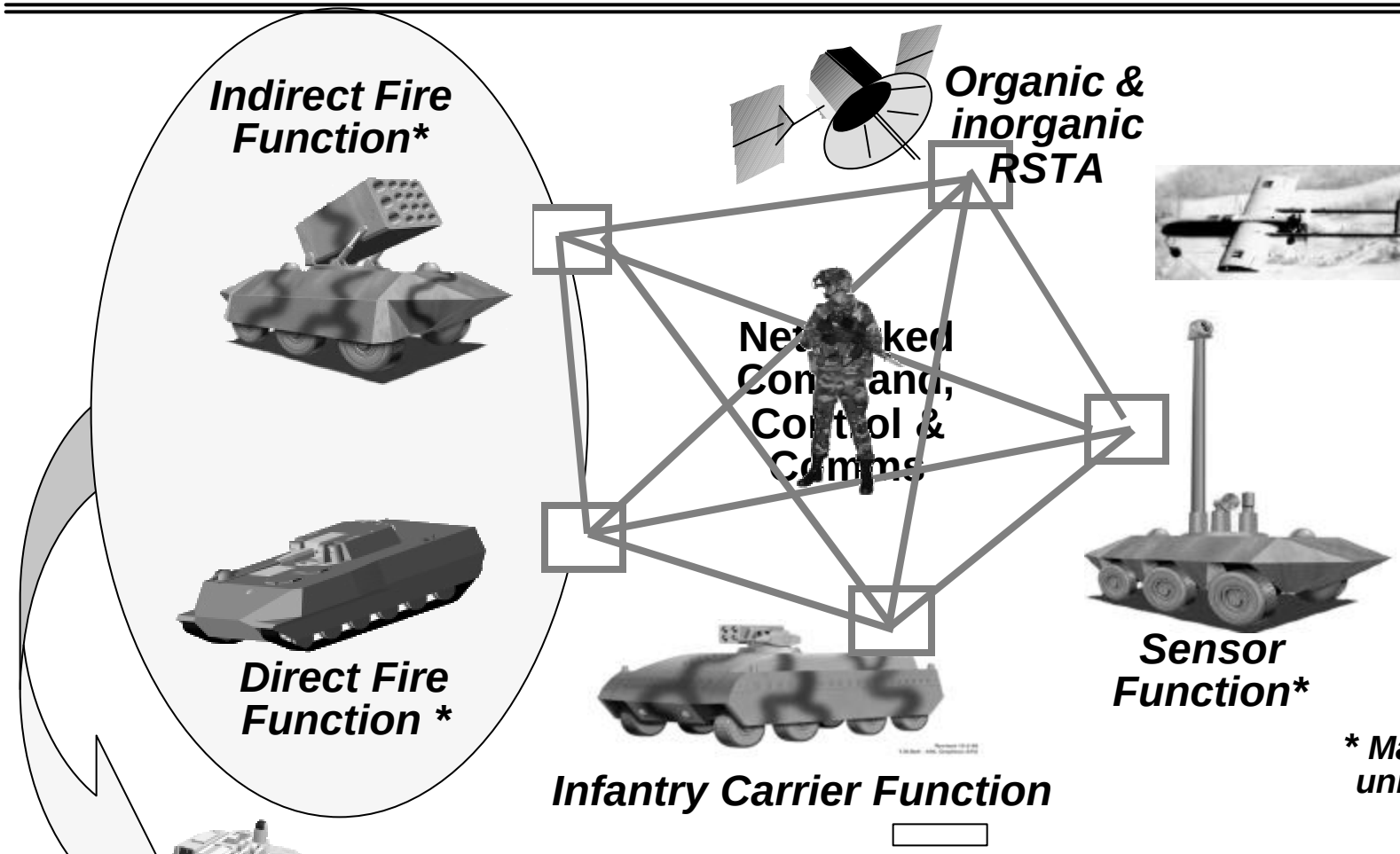
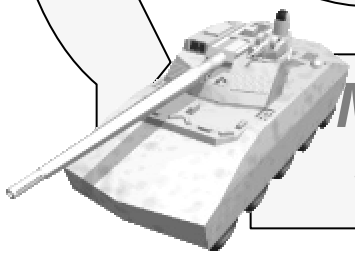
Future Combat Systems Enabling the Objective Force





Multi-Role Armament System is <u>One Platform</u> that provides Direct and Indirect capabilities

FCS Multi-Role Armament & Ammunition System ATD

[redacted]

"One Shot.
....At Least
NLOS 4-5

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One Lightweight Armament System Capable of Dominating the Red Zone and Beyond

The Role of Technology for Lethality

Pacing Technologies

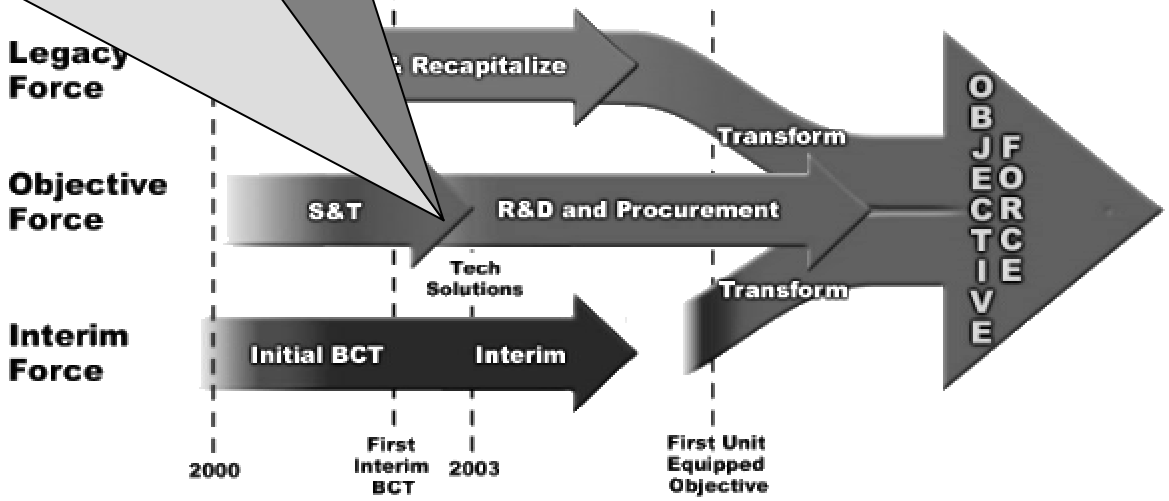
- Recoil management
- Electro-thermal-chemical (ETC) propulsion
- Precision Munitions
- Multi-purpose warheads
- Advanced KE

Armament Capabilities

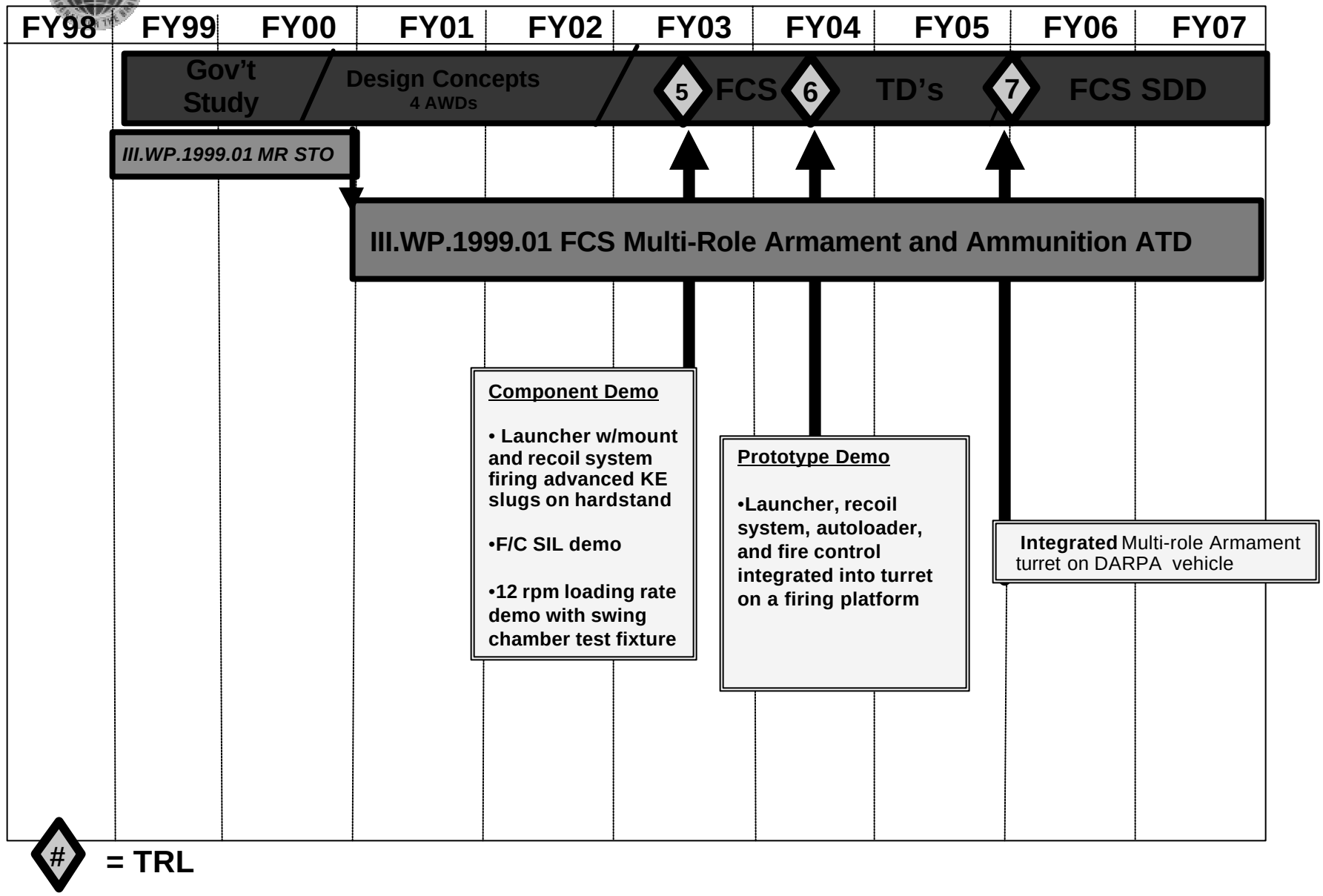
- Rapid engagement of full target spectrum from 0 - 50km.
- Fire on the move, all terrain
- Roll-on / Roll-off from C130 aircraft
- Standoff precision lethality

Force Capabilities

- Dominant at every point on the spectrum of military operations
- Deployable anywhere on earth within 96 hours
- Dominate Red Zone while simultaneously shaping deep battle



FCS Multi-Role Armament ATD Roadmap

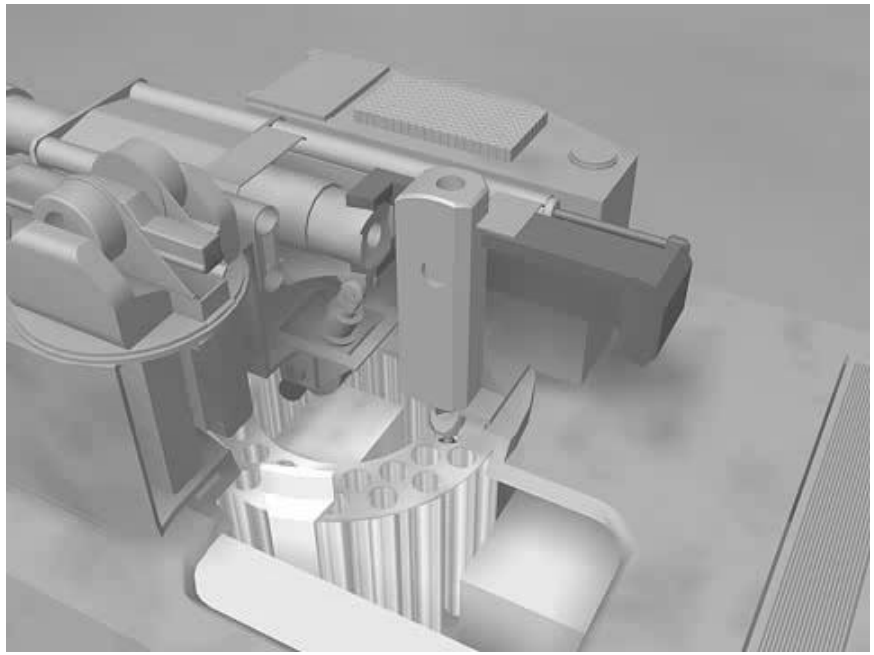


Multi-Role System Trade Study Results

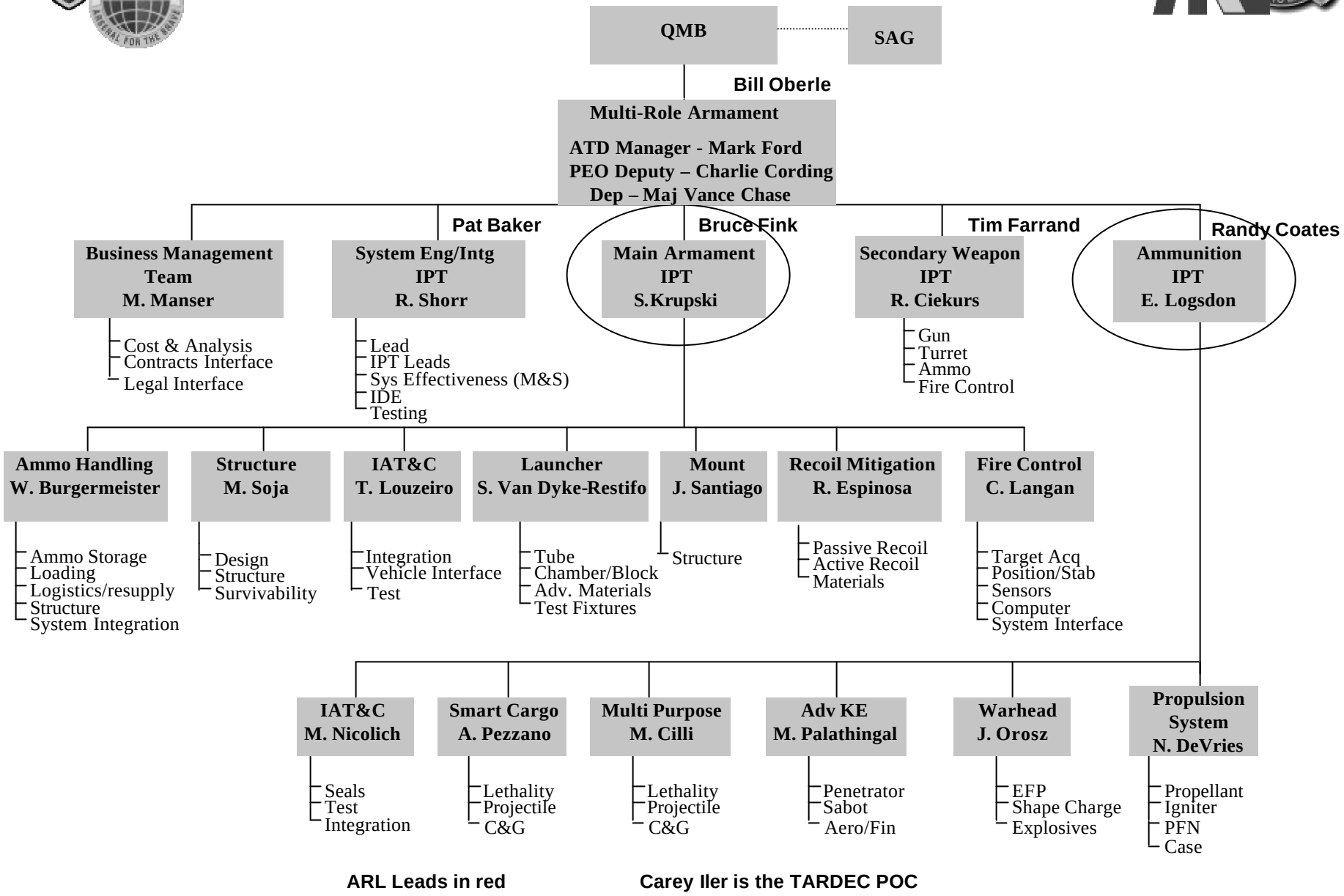
- 105 mm, case telescoped, 150 mm dia x 900 mm long chamber
  - Able to meet our performance goals
  - Smaller, more on-board storage a major driver

- Swing Chamber cannon selected
  - Reduces autoloader and turret weight, size, and cost
  - Readily supports high burst firing rates

- Fire-out-of-battery recoil
  - Offers the best opportunity to reduce recoil force and stroke
  - Allows less structure, minimized vehicle intrusion into ammo space, therefore lighter weight



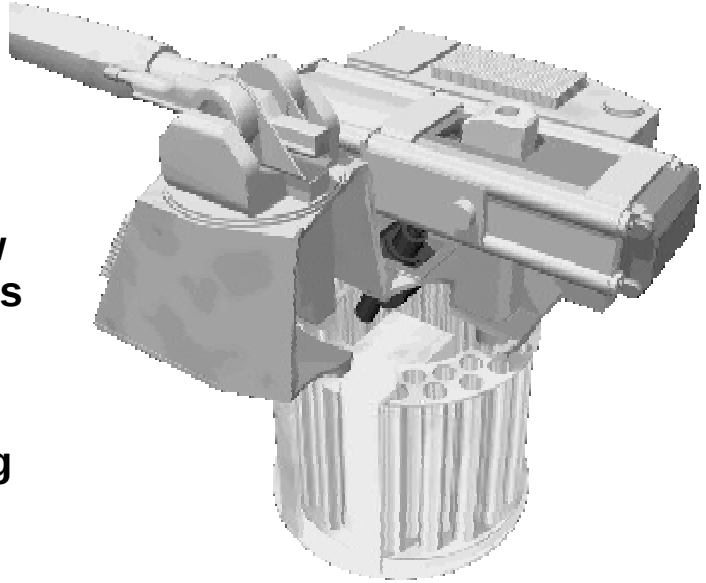
Multi Role Armament/Ammunition
Organization Structure



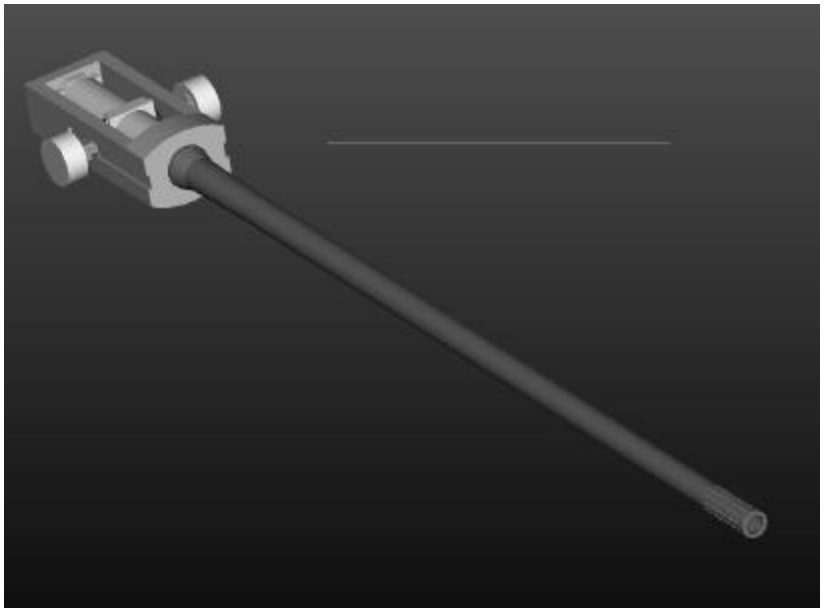
ARL Leads in red

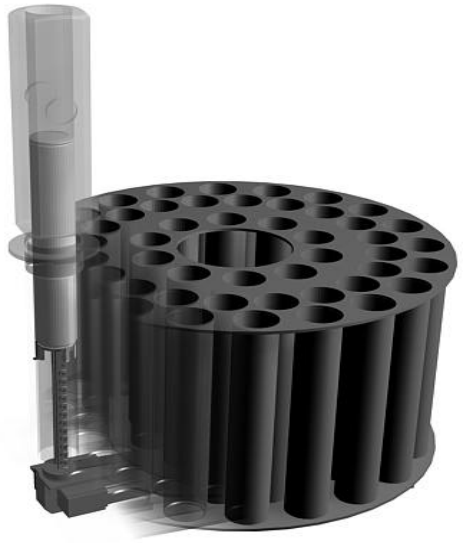
Carey Iler is the TARDEC POC

Multi-Role Armament
Swing Chamber Cannon / Autoloader



- Main Armament
  - Launcher with swing chamber – CTA
    - **Compact ammo handling needed to allow more room for stowed ammo – 40 to 50 rds**
    - **Enable 15-20 rounds/min burst firing rate**
    - **Cannon weight to be 3500 / 3000lbs**
    - **Direct/Indirect fire -10 to +55 degree firing elevation**





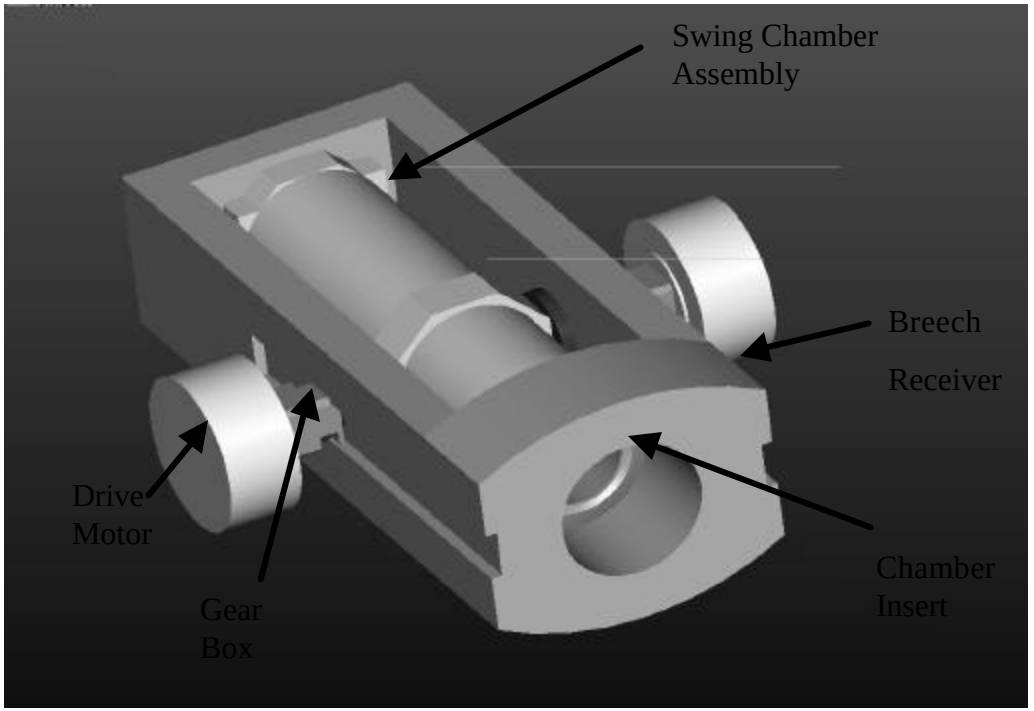
Swing Chamber Cannon Details

–**Materials**

- **High strength steels, 200KSI yield strength**
- **A723, AF1410, Clarm HB7, are candidates**
- **Utilized in chamber for TRL 5 demo, tube & breech receiver for later demonstrations**

–**Composites**

- **Longitudinal overwrap to be applied to increase stiffness**
  - **Reduces fire control burden to track muzzle**
- **Hoop overwraps of muzzle end will help reduce gun weight, imbalance, and decrease stabilization requirements**
- **Application to breech receiver to reduce stretch and weight**



–**Tube bore protection**

- **Ammo test tubes for first firings to be chrome plated**
- **Tantalum sputtered bore surfaces to be evaluated for 2nd generation gun in integrated turret demo**

Autoloader

•Simple direct load at any gun elevation

•40-50 Stowed Rounds

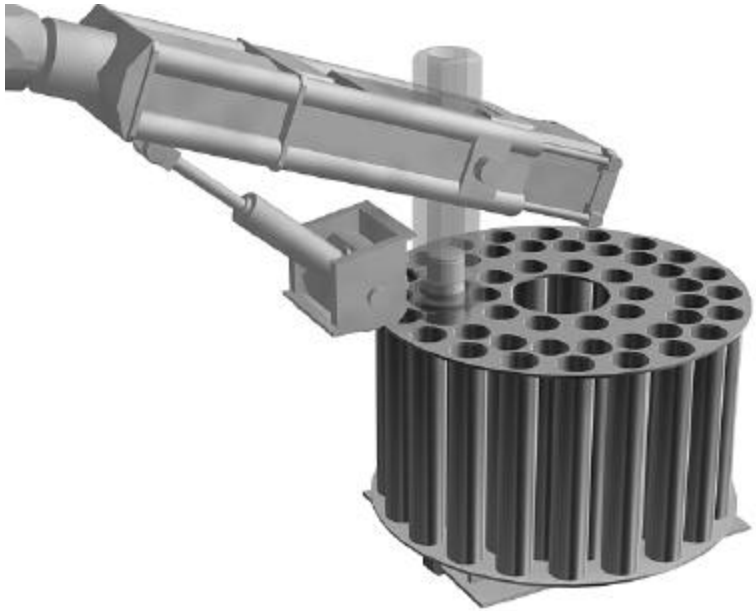
• Weight < 900lbs.

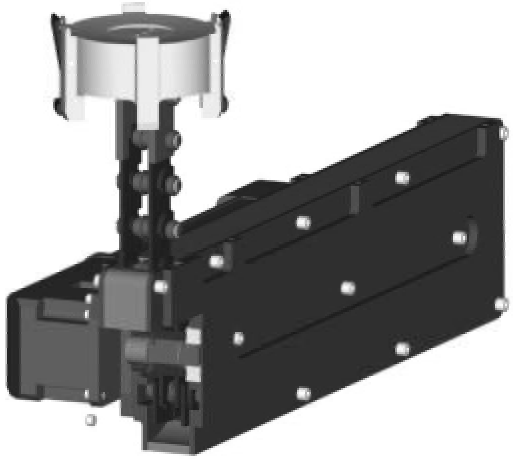
• Burst Loading Rate: 15 to 20 rounds/min

• Load on the Move (Direct and Indirect Fire)

• Cell design requires consideration of ammunition vulnerability

•Storage system configuration being optimized for the best system fit





•Loading test fixture being developed

•Drives, motors, power requirements

•Rammer configuration

•Velocity control to push out an empty case and load new round

Recoil: Two Paths

Manage Recoil Momentum

- Fire out of Battery
- Extended Recoil Stroke
- Increased Recoil Mass
- Ergonomic Man/Machine Interface
- Active Suspension

Reduce Recoil Momentum

- Benign Muzzle Brakes
- Sonic Rarefaction Wave Gun
- Low Impulse Ammunition

Fire Out Of Battery (FOOB)

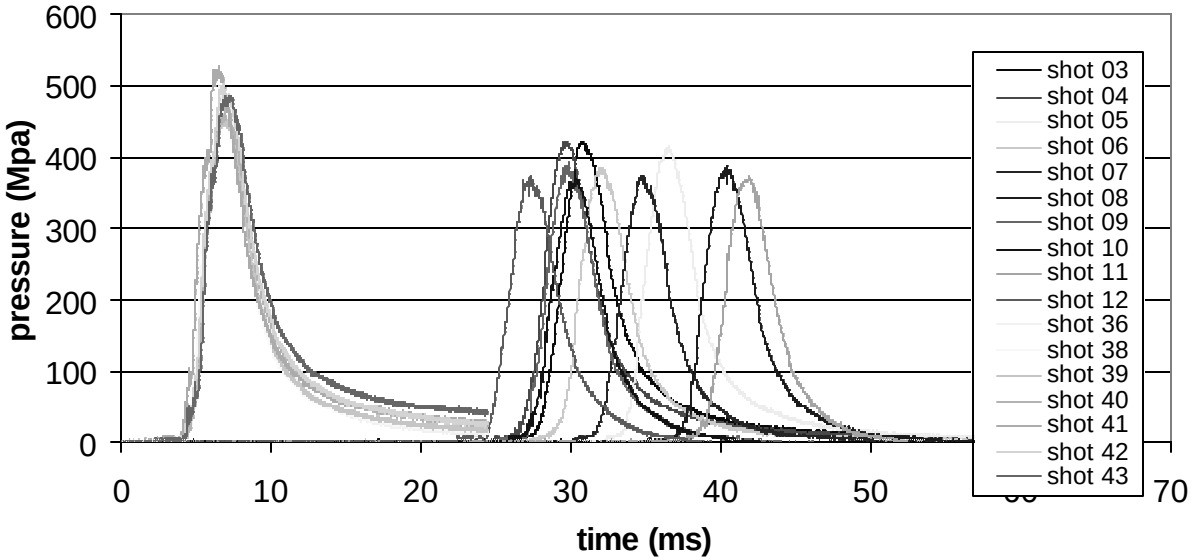
Challenge: Fire a high impulse round (30-40% higher than current 105mm) from a 18 ton class system

FOOB TECHNICAL DESCRIPTION

- **Pre-accelerates cannon forward prior to firing**
  - **Forward momentum of gun partially cancels rearward momentum imparted by round**
- **Reduces recoil reaction force and/or stroke**
- **Facilitates shorter recoil strokes and less vehicle intrusion**
  - **More space for stowed rounds**
  - **Greater gun elevation capability**
  - **Less structure volume, less armor requirement**
- **Incorporates ETC ignition**
  - **Precision timing for FOOB**
  - **Precision ignition enhances accuracy**

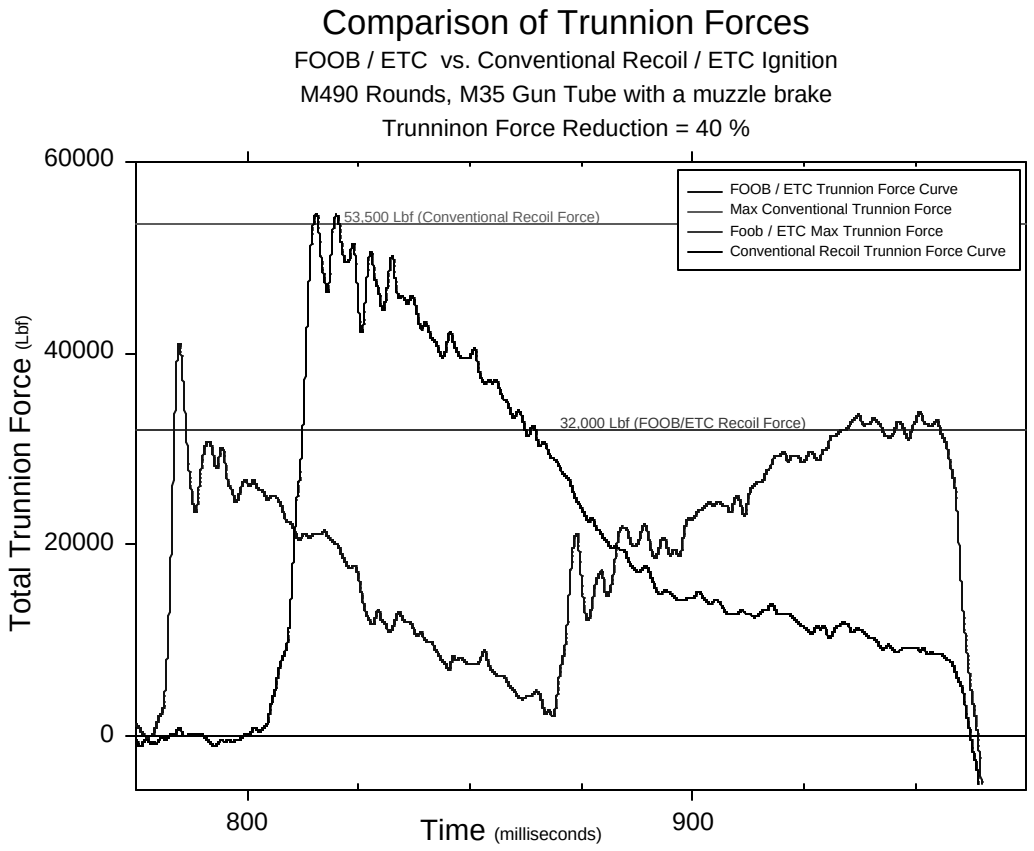
Modified 105mm M35 gun

105mm Conventional and ETC Ignition



Ignition Type	Conventional	ETC
Number of shots	10	10
Velocity (average)	1192 m/s	1209 m/s
T2 Time (average)	31.4 ms	4.66 ms
T2 Sigma	4.85 ms	0.150 ms

Fire-out-of-battery (FOOB) Surrogate Gun Demo
Trunnion Force Comparison

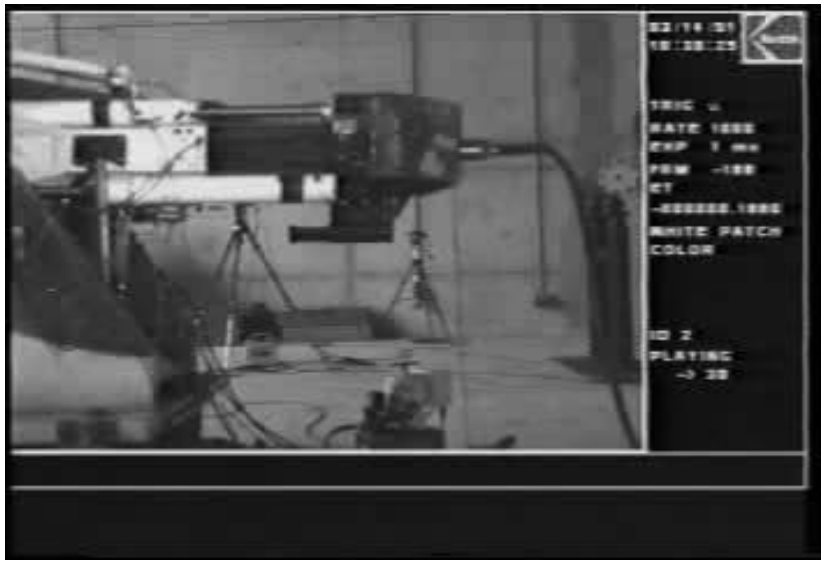


12-16 March - Fired:

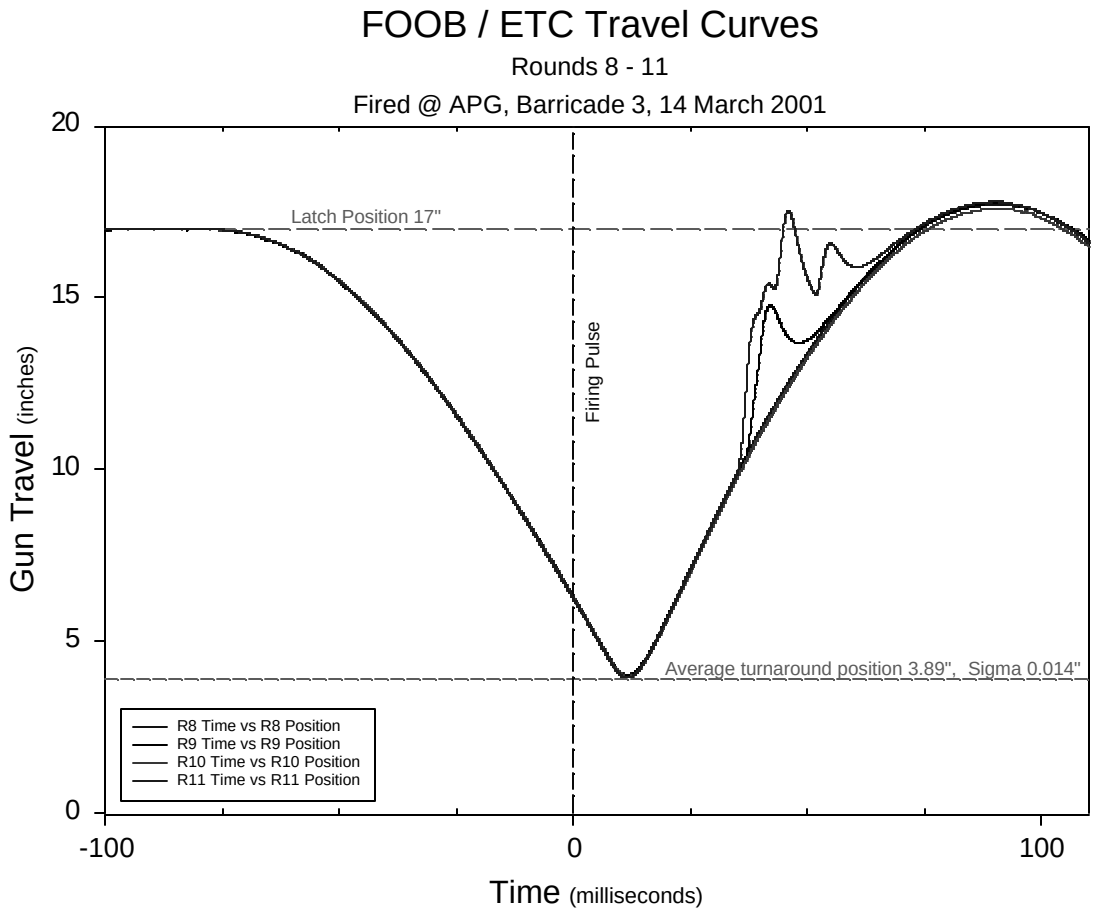
- **7 M490 FOOB/ETC Rounds**
- **5 "Conventional" FOOB Rounds**
- **5 Conventional Recoil Rounds**
- **5 Conventional Recoil w/ETC**

Utilized 105mm M35 gun w/modified recoil system & muzzle brake

Trunnion force reduction of 40% for FOOB/ETC vs. conventional recoil



Fire-out-of-battery (FOOB) Surrogate Gun Demo
ETC Precision Ignition Gun Travel

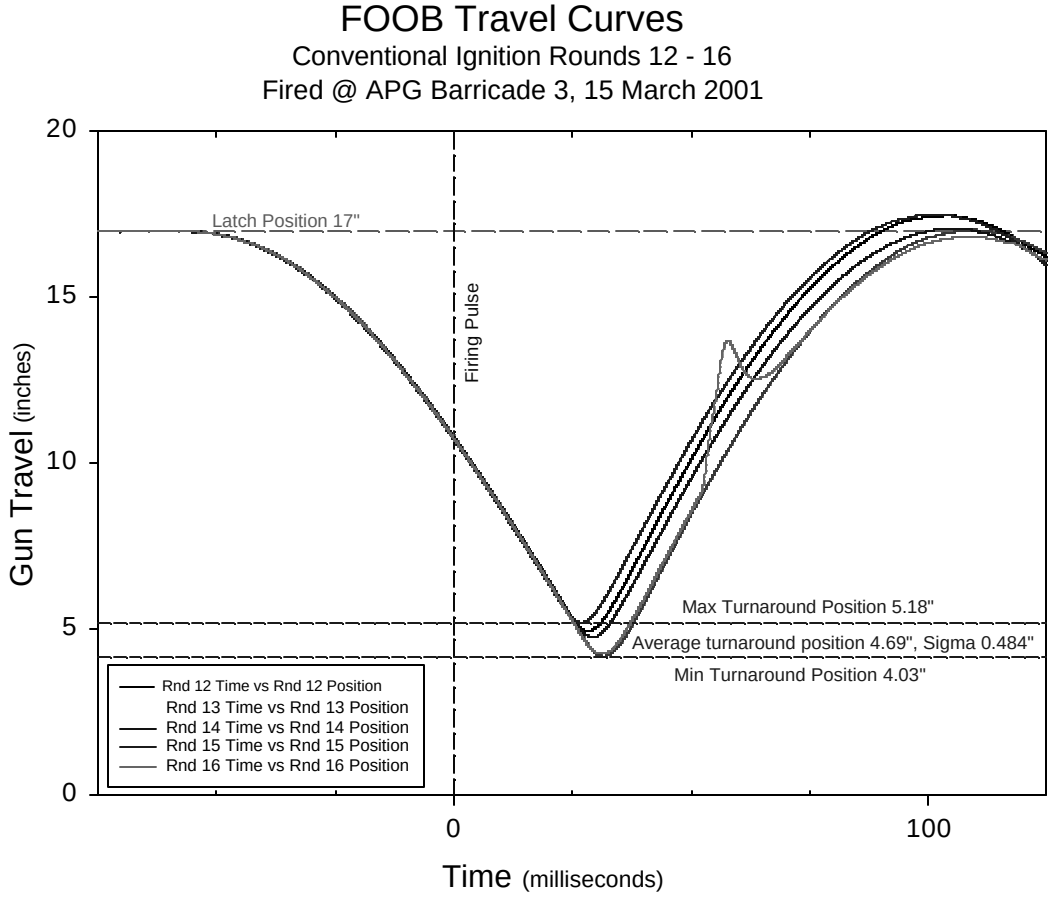


Rounds fired 12-16 March :
- **M490 FOOB/ETC Rounds**
- **M35 gun with FOOB recoil, ETC ignition & muzzle brake**

Precise ETC ignition results in a very repeatable gun travel, i.e. very little variation in turnaround point & max recoil position.

Consistent gun travel makes FOOB a viable technology.

Fire-out-of-battery (FOOB) Surrogate Gun Demo
Conventional Ignition Gun Travel

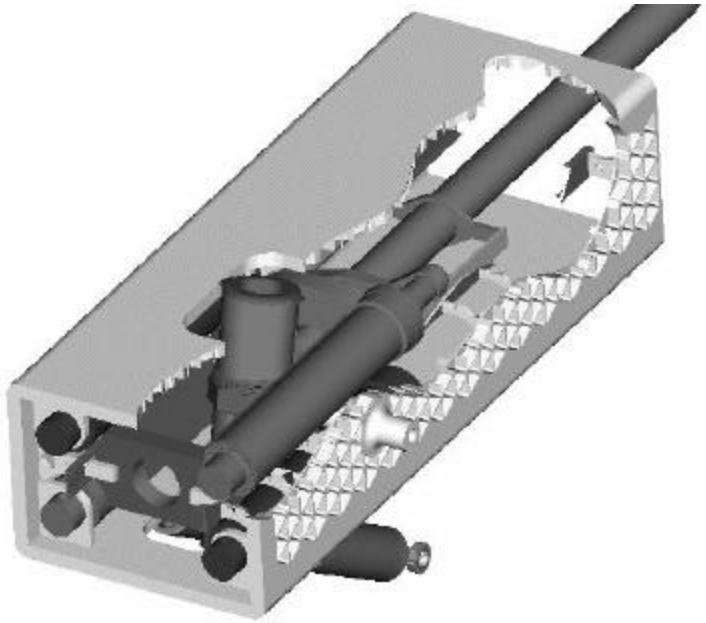


Rounds fired 12-16 March :
- **M490 FOOB/ETC Rounds**
- **M35 gun with FOOB recoil, Conventional ignition & muzzle brake**

Conventional ignition results in inconsistent gun travel, i.e. wide variation in turnaround point & max recoil position.

Inconsistent gun travel precludes FOOB because of unreliable latching & gun over-travel

Mount & Recoil System



- **Cradle structure**
  - Must rigidly support the gun for pointing
    - Require a lightweight structure
    - **High Strength Steels**
    - **ISO - GRID Structure**
  - Configured to minimize gun imbalance
  - Latching mechanism with controls for FOOB
- **Recoil System**
  - Adaptive recoil system required for varying impulse and firing elevation
    - Magneto-Rheological, Electro-Rheological, (MR or ER) fluids
    - Linear motors
    - Servo valves
  - Recoil system and cradle design must be compatible with swing chamber

Multi-Role Fire Control

- Technical (Platform) Fire Control
  - Increase accuracy – Direct & Indirect fire
    - Improved weapons pointing – gun drives and stabilization
    - Projectile tracking
    - Environmental sensing
    - Cannon muzzle tracking
    - Improved ballistics processing

- Tactical Fire Control
  - Decision aids/DIFM (Multi-Agent) software being developed
  - Coordinating efforts with OGA & industry

Summary

Accomplishments

- **FOOB / ETC technologies have been demonstrated together**
- **Trade study completion allows focus on hardware design**
- **Objective system concepts have been prepared and are being refined**
- **1st firing fixture for CTA rounds designed, built, and fired**
- **Fire control source selection in process**

Plans

- **Optimize recoil stroke, FOOB velocities, muzzle brakes to suit vehicle structure and stability requirements**
- **Refine vehicle models with TARDEC & industry**
- **Resupply concepts to be developed**
- **Detailed designs of TRL 5 test hardware to be completed this winter for start of fabrication early ‘02**
- **Award fire control development contract**